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PICTURE OF THE MONTH

An Atlantic Cold Front, Satellite Infrared and Visual Data Compared

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Clouds viewed in infrared (IR) are similar in appearance to familiar TV data that meteorologists routinely use in daily weather analysis. Improved TIROS operational satellite 1 (ITOS 1), the first of a new generation of operational satellites, provides simultaneous data in both the visible and infrared spectral regions.

Figures 1A and 1B depict clouds associated with the North Atlantic cold front shown in the analysis of figure 2. Figure 1A is a portion of a standard ITOS automatic picture transmission (APT) photograph. Figure 1B is the infrared view acquired at the same time and over the same area as figure 1A. The IR picture is more fore-

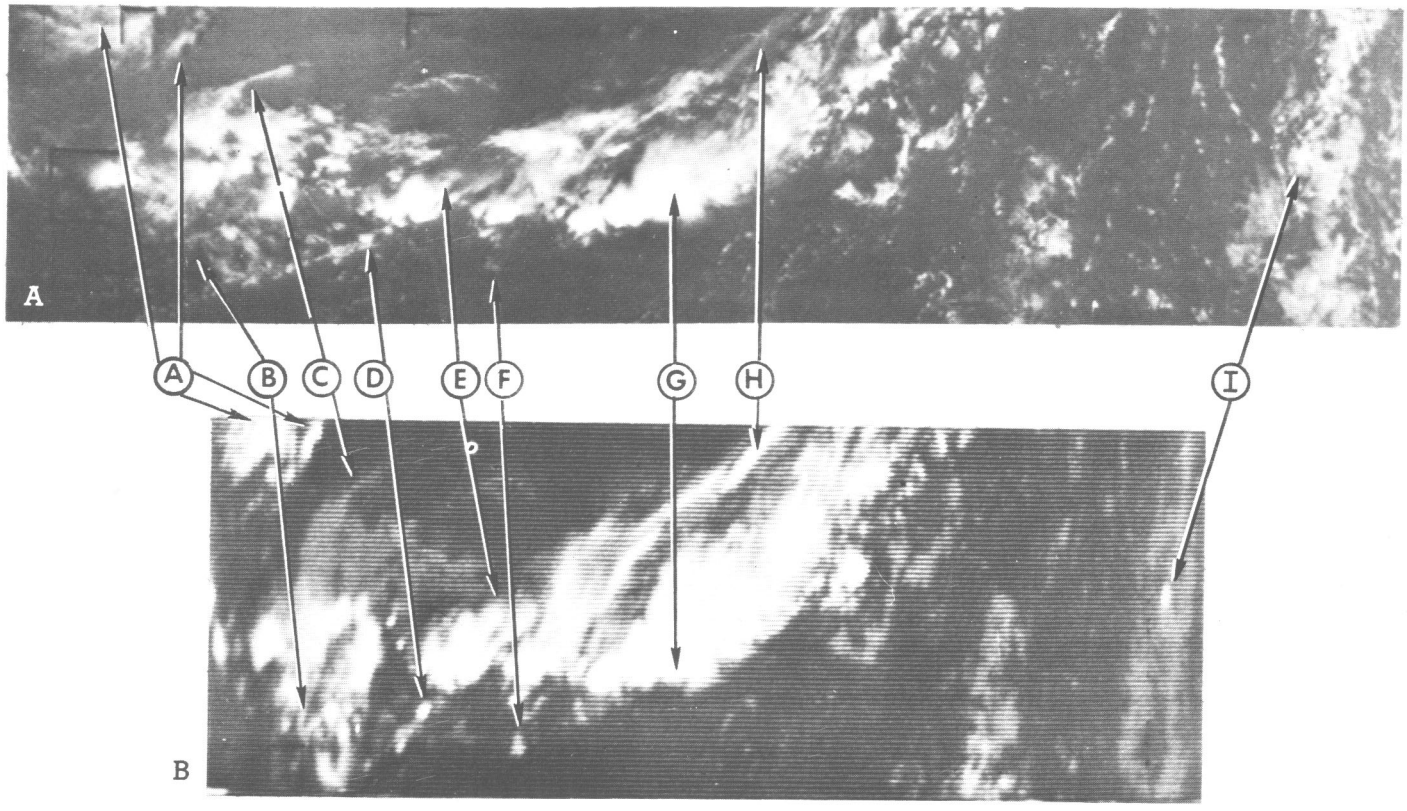

FIGURE 1.—(A) portion of an ITOS 1 APT picture at 1803 GMT on Sept. 4, 1970 (resolution at center is 2 mi); (B) a direct readout infrared (DRIR) from ITOS 1 taken at the same time and covering the same area as (A), (resolution at center is 4 mi).

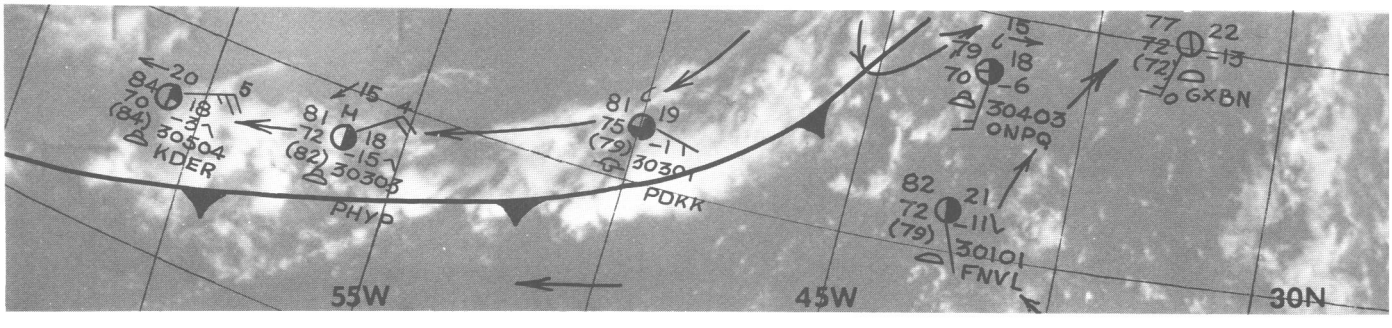

FIGURE 2.—Surface front and low-level flow for 1800 GMT on Sept. 4, 1970, superimposed on figure 1A.

shortened on the right and left sides than the APT and is stretched from top to bottom. Although there are differences in the aspect ratio of the two pictures, the same cloud elements are easily recognized in both photographs. In the IR view, white corresponds to the coldest temperatures (highest clouds), and black represents the warmest return (ocean surface).

The most striking difference between the two pictures is that the cold cirrus clouds are more detectable in the IR data than they are in the corresponding video picture. This is apparent north of the front at point A and between E and H, and south of the front at points B and F. Much of this cirrus appears thin[1] in the video picture, and some of it is not readily identifiable as cirrus. Comparisons of ITOS simultaneous video and infrared data indicate that cirrus clouds which can be identified in video data can always be identified in IR imagery. Cirrus is often more obvious in the infrared than in the video because the IR sensor produces a greater contrast between the cold (white) cirrus cloud and its warmer (darker) background. In the video, there is lower contrast between the reflectivity of ice crystal clouds and the low-reflecting (dark) land and ocean surfaces. Very thin cirrus cannot be recognized in either type of imagery. In the video data, it has too low a reflectivity to be identified; and in the infrared, it appears as a warmer and therefore apparently lower cloud since thin cirrus is transparent to a certain percentage of the warmer radiation coming from underlying surfaces.

The IR picture provides more information on the height, temperature, and distribution of the clouds between points B and C than does the APT view. Note in the video picture (fig. 1A) that the clouds north of the front near C appear brighter than those to the south around B; but in the IR view, the clouds at point B are the brightest (coldest and highest) of the two areas. The clouds at point A appear much colder and therefore higher than the clouds at C in the IR imagery. In the video, the two areas appear quite similar.

A comparison of simultaneous IR and video data permits the identification of those cumulonimbi that are active and growing and those that are not. For example, the convective cluster at G appears equally bright in both the IR and the video. This indicates an area of active convection where the clouds are both highly reflective and have cold tops. In the IR, the cloud elements at D and F are nearly equal in brightness. However, in the video, the element at F is less bright (darker) than the one at D. This suggests that cloud element D is an active convective cell, whereas F is a dead anvil. In figure 1B, note the bright cloud at point I in the IR. This same element in the video also appears bright indicating active convection. In the video, this convection is not at all obvious; whereas in the IR picture, it is easily detectable even though quite small.

In summary, a comparison of the ITOS infrared and video data indicates:

1. Cirrus clouds that can be identified in video data can always be identified in IR imagery.
2. Cirrus is often more obvious in the infrared than in the video.
3. Relative cloud heights and temperatures can be inferred from IR data.
4. Deep active convection can be differentiated from dying thunderstorms when IR and video data are compared.
5. The IR data provides as much and sometimes more information than the video.
6. Maximum usefulness of satellite data can be realized best when both IR and video data are available for interpretation.

ACKNOWLEDGMENT

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[1] Cirrus is interpreted as *thin* in a video picture when it appears gray over a dark underlying surface as the ocean in this example. In figure 1A, the cirrus at (H) would be interpreted as thinner than the cirrus at (A).